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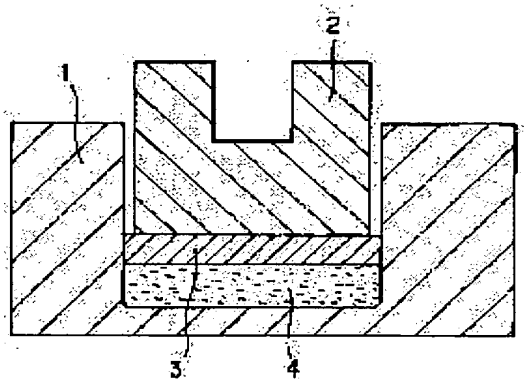
(71)Applicant : NGK INSULATORS LTD
(72)Inventor : ISHIKAWA TAKAHIRO
SHINKAI MASAYUKI
KIDA MASAHIRO

(54) METHOD FOR JOINING DIFFERENT KINDS OF MEMBERS TO EACH OTHER, AND COMPOSITE MEMBER JOINED BY THE SAME METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method for joining different kinds of members to each other to produce a composite member having a fit structure not having a space into which a prescribed amount of a hard brazing material can not be poured.
SOLUTION: This method for producing a composite member which comprises different kinds of members and has a fit structure comprises uniformly spreading a particulate substance 4 on the surface of the depressed portion of a member 1 having the depressed portion, disposing a plate-like or powder-like hard brazing material 3 on the spread particulate substance 4 to cover at least its one part, and then fitting a member 2 having a projected portion, or spreading the particulate substance 4 on the depressed surface and then fitting a projected member having a layer comprising the hard brazing material formed thereon, and then heating the combination to melt and impregnate the hard brazing material into the particulate substance, thus forming the joining layer comprising the hard brazing material and the particulate material.



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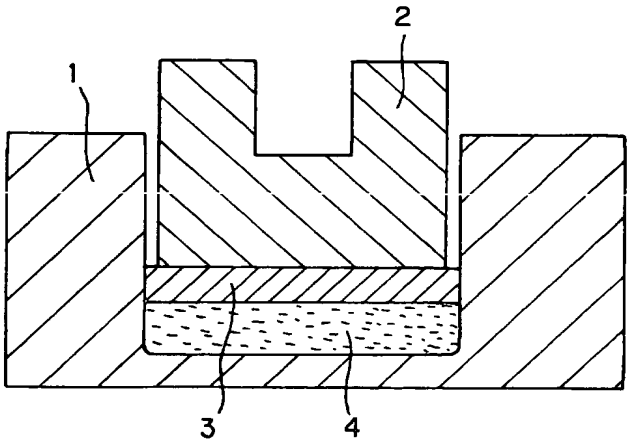
(71)出願人　000004064
日本碍子株式会社
愛知県名古屋市瑞穂区須田町2番56号
(72)発明者　石川　貴浩
愛知県名古屋市瑞穂区須田町2番56号　日本碍子株式会社内
(72)発明者　新海　正幸
愛知県名古屋市瑞穂区須田町2番56号　日本碍子株式会社内
(74)代理人　100088616
弁理士　渡邊　一平

最終頁に続く

(54)【発明の名称】異種部材の接合方法、および同接合方法により接合された複合部材

(57)【要約】　(修正有)
【課題】所定量の硬ろう材を流し込み得るだけの間隔を有しない、嵌合構造を有する異種部材の接合方法。
【解決手段】凹部を有する部材１の凹部表面に微粒子状の物質４を均一に敷き詰め、少なくともその一部を被覆するように板状あるいは粉体状等の硬ろう材３を配置し、凸部を有する部材２を嵌合するか、凹部表面に微粒子状物質を敷き詰め、硬ろう材からなる層を形成した凸状部材を嵌合し、加圧下で加熱し、硬ろう材を溶融して微粒子状の物質中に含浸させて、硬ろう材と微粒子状の物質とからなる接合層を形成し、嵌合構造を有する異種部材同士からなる複合部材を製造。



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【特許請求の範囲】

【請求項１】　嵌合構造を構成する凹部を有する部材と、嵌合構造を構成する凸部を有する部材であって凹部を有する部材とは相異なる種類の部材とを、嵌合させ接合するに際して、

凹部を有する部材の凹部表面に微粒子状の物質を均一に敷き詰めた上で、該微粒子状の物質からなる層の少なくとも一部を被覆するように板状あるいは粉体状等の硬ろう材を配置し、更に凸部を有する部材を配置するか、

凹部を有する部材の凹部表面に微粒子状の物質を均一に敷き詰め、該微粒子状の物質からなる層に密着するように、１または複数の穿孔された穴に硬ろう材が挿入された凸部を有する部材を配置するか、

あるいは、予め先端部に硬ろう材と微粒子状の物質からなる層を形成した凸部を有する部材を用意しておき、凹部を有する部材の凹部表面に硬ろう材を配置した上に当該層を有する凸部を有する部材を配置する工程と、

かくして用意したものを加圧下で所定の温度に加温して、該硬ろう材を溶融して、微粒子状の物質中に含浸させて該硬ろう材と微粒子状の物質とからなる接合層を形成して、異種部材同士を嵌合構造を介して接合する工程からなる異種部材同士からなる複合部材を製造する方法。

【請求項２】　上記凸部を有する部材を配置する工程が凹部を有する部材の凹部表面に微粒子状の物質を均一に敷き詰めた上で、該微粒子状の物質からなる層の少なくとも一部を被覆するように板状あるいは粉体状等の硬ろう材を配置し、更に凸部を有する部材を配置することからなる請求項１に記載の方法。

【請求項３】　上記凸部を有する部材を配置する工程が、凹部を有する部材の凹部表面に微粒子状の物質を均一に敷き詰め、該微粒子状の物質からなる層に密着するように、１または複数の穿孔された穴に硬ろう材が挿入された凸部を有する部材を配置する配置することからなる請求項１に記載の方法。

【請求項４】　上記凸部を有する部材を配置する工程が、予め先端部に硬ろう材と微粒子状の物質からなる層を形成した凸部を有する部材を用意しておき、凹部を有する部材の凹部表面に硬ろう材を配置した上に当該層を有する凸部を有する部材を配置することからなる請求項１に記載の方法。

【請求項５】　該異種部材の少なくとも一方がセラミック製部材であることを特徴とする請求項１ないし４のいずれか１項に記載の方法。

【請求項６】　該異種部材の一方がセラミック製部材で、他方が金属製部材であることを特徴とする請求項１ないし５のいずれか１項に記載の方法。

【請求項７】　該微粒子が熱応力を低下させる微粒子状の物質であることを特徴とする請求項１ないし６のいずれか１項に記載の方法。

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【請求項８】　該硬ろう材のベース金属が、Ａｕ、Ａｇ、Ｃｕ、Ｐｄ、ＡｌまたはＮｉである硬ろう材であり、該微粒子状の物質がセラミック微粒子、サーメット微粒子、または低膨張金属微粒子であることを特徴とする請求項１ないし７のいずれか１項に記載の方法。

【請求項９】　該微粒子状の物質が、その表面がメッキまたはスパッタにより金属で被覆されたセラミック微粒子であることを特徴とする請求項１ないし８のいずれか１項に記載の方法。

【請求項１０】　嵌合構造を構成する凹部を有する部材と、嵌合構造を構成する凸部を有する部材であって凹部を有する部材に対して異種の部材とからなり、上記異種部材は相互に嵌合され、微粒子状の物質と硬ろう材からなる接合層により接合されている複合部材。

【請求項１１】　該二種以上の異種部材の少なくとも一つがセラミック製部材である請求項１０に記載の複合部材。

【請求項１２】　該二種以上の異種部材が金属製部材とセラミック製部材との組み合わせである請求項１０または１１に記載の複合部材。

【請求項１３】　該微粒子が熱応力を低下させる微粒子状の物質であることを特徴とする請求項１０に記載の複合部材。

【請求項１４】　該硬ろう材のベース金属が、Ａｕ、Ａｇ、Ｃｕ、Ｐｄ、ＡｌまたはＮｉである硬ろう材であり、該微粒子状の物質がセラミック微粒子、サーメット微粒子、または低膨張金属微粒子であることを特徴とする請求項１０ないし１３のいずれか１項に記載の複合部材。

【請求項１５】　該微粒子状の物質が、その表面がメッキまたはスパッタにより金属で被覆されたセラミック微粒子であることを特徴とする請求項１０ないし１４のいずれか１項に記載の複合部材。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】　本発明は、嵌合構造を介して接合された二種以上からなる異種部材を接合してなる複合異種部材、および同複合異種部材の接合方法に関する。更に詳しくは、異なる二種以上の部材からなる複合部材であって、該異種部材同士が嵌合構造を介して、膨張係数が制御された接着剤組成物で接合された複合部材、および同複合部材を製造するための二種以上の異種部材同士を膨張係数が制御された接着剤組成物で接合する方法に関する。

【０００２】

【従来の技術】　異種部材の接合、例えば、セラミック製部材と金属製部材との接合には、ろう材を用いる方法があるが、高温での接合後の冷却操作中に、異種部材間、あるいはこれら異種部材を接合するために使用したろう材と部材との熱膨張率の差に起因する熱応力が発生

し、接合界面に剥離を生じたり、また、一方の部材が脆弱な場合には、接合界面近傍にクラックを生じたりして、所望の接合強度や気密性を得られないことがある。製造過程でこれらの異常が発生した製品は、不良品として処分せざるを得ないためにこれら複合部材の製品のコストを押し上げる一因となっている。また、使用時に熱サイクルがかかる場合には、これらの異常が一定期間の使用後に発生して、製品の信頼性を低下させる一因ともなっている。

【０００３】　異種部材をろう材を用いて接合する場合には、セラミック製部材とろう材との濡れを確保するためにセラミック製部材の接合面の表面を金属、例えば、Ｎｉ等の金属でメッキした後、両部材を適当な間隔をおいて向かい合わせて配置させ、この間隔にろう材を流し込み、接合させる方法が通常採用されている。また、金属メッキ処理がなくてもセラミック表面に窒化物、酸化物等の反応層を形成することで濡れを確保することができるＴｉ等の添加物をろう材中に加える手法もある。しかしながらこれらの方法では、熱応力を低下させるのには、充分でなく、熱応力に対して脆弱なセラミック製部材側にしばしばクラックが形成されたり、接合部に剥離を生じたりして、結合強度ばかりでなく複合部材として要求される気密性などの各種性能に影響を及ぼすので好ましくない。また、熱応力を緩和する方法としては、接合の際に熱膨張率の低い金属を中間材として使用する方法、セラミックとの反応性に富み、塑性変形することにより応力を緩和することのできる軟質金属を中間材として使用する方法が通常採用されている。しかし、これらの技術も、ろう材と部材間の熱膨張差に起因する問題、例えば熱サイクル特性の低さ等が問題とされており、必ずしも汎用性の高い技術とは言えない。また、現在開発中の技術として高圧固相接合法があるが、実用化するには未解決の課題があり、従って、この方法では充分な結合強度がでていないのが現状である。

【０００４】　一方、複合半田としては、半導体チップと基板との固着に使用するものであって、半田よりも融点の高い材質からなる粉末体を混合したものが特開平６－１２６４７９号公報に開示されているが、この複合半田は、半田本体の中央部にのみ半田よりも融点の高い材質からなる粉末体を充填させることにより、従来の複合半田が有している表面にも存在している粉末体に起因する半田濡れ不良を解消すること、換言すれば、接合界面での接合強度を増加させることを目的とするものであるが、しかし、この複合半田は、熱応力の低下には有効ではなく、従って、接合される部材間あるいは部材とろう材間の熱応力に起因する問題を解決するのには有効ではない。

【０００５】　本発明者等は、上記の目的を達成するために種々検討の結果、異種部材同士を適度な結合強度を保持しながら、高温での接合後における冷却操作の間の熱応力による接合界面近傍での接合強度の低下現象や、熱応力に対して弱い部材での冷却操作中にクラックを発生させない、二種以上の異種部材間の接合用接着剤組成物を見出した。その具体的な内容については、平成１０年２月１８日に特願平１０－５２９７１号として出願している。

【０００６】　即ち、上記の様な現状に鑑みて種々検討した結果、接合部材の種類や形状等による制約が少なく、接合形状も選択の余地の多い硬ろう材をベースとして用いること、この硬ろう材に熱応力を低下させる微粒子状の物質を添加することにより、異種部材同士を適度な結合強度を保持しながら、高温での接合後における冷却操作の間の熱応力による接合界面近傍での接合強度の低下現象も起こさず、また、熱応力に対して弱い部材での冷却操作中にクラック発生させず、二種以上の異種部材間の接合達成できることを見いだし、上記特許出願に至ったものである。

【０００７】　上記の組成物を使用して接合する方法として、相互にその熱応力を異にする二種以上の異種部材同士を接合させるのに充分な間隔を置いて互いに向かい合わせに配置させ、該間隔に上記組成物を流し込むか、所定量のセラミックまたはサーメット微粒子を充填し、引き続いて溶融状態にした所定量の硬ろう材を流し込み、ついで冷却して該二種以上の異種部材同士を接合させて複合部材を製造する方法を上記特許出願において開示しているが、所定量の硬ろう材を流し込み得るだけの充分な間隔を有しない部材同士の接合には、そのままでは、使用できない。

【０００８】　嵌合構造を介して接合しなければならない二種以上からなる異種部材を接合する場合、特に、クリアランスとして、０．０１～０．３０ｍｍ程度の極めて狭いものを選択し、両部材を接合しようとしたときには、部材の側面にも極力全般的に均等にろう材を充填しないと、種々の不都合が生じることが少なくない。一方、該クリアランスが上記の上限よりも大きい場合には、ろう材の溶融時に、ろう材が該クリアランスに均等に充填されないことにより発生する内包された残留応力により、クラックが発生することがある。これをより具体的に説明すると、例えば、円柱状の凹部を有する部材と円柱状の凸部を有する部材を嵌合する際に、両部材から形成される円柱状のクリアランスに均等に充填されるべきろう材が、該クリアランスがある程度の余裕があるために、何かの原因で一方のみに片寄ってしまうと、ろう材を冷却、凝固させる過程での熱収縮応力のバランスが崩れて、円柱状の凸部を有する部材が一方向に引っ張られ、その結果残留応力が生じて、クラックを発生させてしまうことがある。さらに、完成品としての複合部材の寸法精度上の要請や美観上の要請もある。従って、このように上記のような狭いクリアランスしかない部材同士に、この狭いクリアランスから所定量の硬ろう材を流

し込みことは実質的に不可能であるので、該異種部材同士を上記方法により接合することはできなかった。なお、ここでクリアランスとは、嵌合構造部分における該異種部材同士の壁面間に存在する隙間の幅をいう。

【０００９】

【発明が解決しようとする課題】　従って、本発明が解決しようとする課題は、該異種部材同士の接合にするときに、嵌合構造部分における該異種部材同士の壁面間のクリアランスが、所定量の硬ろう材を流し込み得るだけの充分な間隔を有しない場合において、該異種部材同士を、嵌合構造を介して膨張係数が制御された接着剤組成物で接合層を形成し接合する方法、および同方法により接合された異種部材を提供することにある。

【００１０】

【課題を解決するための手段】　本発明者等は、上記の課題を解決するために、種々検討の結果、嵌合構造を構成する凹部を有する部材と、嵌合構造を構成する凸部を有する部材であって凹部を有する部材とは相異なる種類の部材とを、嵌合させ接合するに際して、凹部を有する部材の凹部表面に微粒子状の物質を均一に敷き詰めた上で、該微粒子状の物質からなる層の少なくとも一部を被覆するように板状あるいは粉体状等の硬ろう材を配置し、更に凸部を有する部材を配置して、加圧下で所定の温度に加温して硬ろう材を溶融し、この溶融した硬ろう材を該微粒子状の物質からなる層中に浸透させ、該硬ろう材と微粒子状の物質からなる膨張係数が制御された接着剤組成物による接合層を形成するか、嵌合構造を構成する凹部を有する部材と、嵌合構造を構成する凸部を有する部材であって凹部を有する部材とは相異なる種類の部材とを嵌合させ接合するに際して、凹部を有する部材の凹部表面に微粒子状の物質を均一に敷き詰め、該微粒子状の物質からなる層に密着するように、１または複数の穿孔された穴に硬ろう材が挿入された凸部を有する部材を配置し、加圧下で所定の温度に加温して硬ろう材を溶融し、この溶融した硬ろう材を該微粒子状の物質からなる層中に浸透させ、該硬ろう材と微粒子状の物質からなる膨張係数が制御された接着剤組成物による接合層を形成するか、予め先端部に硬ろう材と微粒子状の物質からなる層を形成した凸部を有する部材を用意しておき、凹部を有する部材の凹部表面に硬ろう材のみを配置した上に、当該硬ろう材と微粒子状の物質からなる層が形成された凸部を有する部材を配置し、加圧下で所定の温度に加温して、該凸部を有する部材の先端に形成された硬ろう材と微粒子状の物質からなる層と、凹部を有する部材の凹部表面に配置した硬ろう材とを溶融し、硬ろう材と微粒子状の物質からなる膨張係数が制御された接着剤組成物からなる接合層を形成することにより、異種部材同士を嵌合構造を介して接合できることを見出して、本発明の第１の側面である、嵌合構造を構成する凹部を有する部材と、嵌合構造を構成する凸部を有する部材であって凹部を有する部材とは相異なる種類の部材とを、嵌合させ接合させる方法を完成させてものである。

【００１１】　また、かくして嵌合され接合された、嵌合構造を構成する凹部を有する部材と、嵌合構造を構成する凸部を有する部材であって凹部を有する部材とは相異なる種類の部材とから少なくともなり、上記異種部材同士は相互に嵌合され、微粒子状の物質と硬ろう材からなる膨張係数が制御された接着剤組成物により接合されていることを特徴とする二種以上の異種部材からなる複合部材が、実装後も、改良された熱サイクル特性を有することを見出して、本発明の第２の側面を完成させたものである。

【００１２】

【発明の実施の形態】　本発明の第１の側面は、嵌合構造を構成する凹部を有する部材と、嵌合構造を構成する凸部を有する部材であって凹部を有する部材とは相異なる種類の部材とを、嵌合させ接合するに際して、凹部を有する部材の凹部表面に微粒子状の物質を均一に敷き詰めた上で、該微粒子状の物質からなる層の少なくとも一部を被覆するように板状あるいは粉体状等の硬ろう材を配置し、更に凸部を有する部材を配置するか、凹部を有する部材の凹部表面に微粒子状の物質を均一に敷き詰め、該微粒子状の物質からなる層に密着するように、１または複数の穿孔された穴に硬ろう材が挿入された凸部を有する部材を配置するか、あるいは、予め先端部に硬ろう材と微粒子状の物質からなる層を形成した凸部を有する部材を用意しておき、凹部を有する部材の凹部表面に硬ろう材を配置した上に当該層を有する凸部を有する部材を配置する工程と、かくして用意したものを加圧下で所定の温度に加温して、該硬ろう材を溶融して、微粒子状の物質中に含浸させて該硬ろう材と微粒子状の物質とからなる接合層を形成して、異種部材同士を嵌合構造を介して接合する工程からなる異種部材同士からなる複合部材を製造する方法に関するものである。

【００１３】　なお、上記以外に接合に際して採用される条件、例えば、冷却条件等は、平成１０年２月１８日の出願に係る特願平１０－５２９７１号明細書に記載に従えばよい。従って、平成１０年２月１８日の出願に係る特願平１０－５２９７１号明細書の内容を参考までにここに引用する。

【００１４】　本発明の第１の側面に係る接合方法の第１の態様は、凹部を有する部材（１）の凹部表面に微粒子状の物質（４）を均一に敷き詰めた上で、該微粒子状の物質からなる層の少なくとも一部を被覆するように板状あるいは粉体状等の硬ろう材（３）を配置し、更に凸部を有する部材（２）を配置し、加圧下で所定の温度に加温して硬ろう材を溶融させ、溶融させた硬ろう材を該微粒子状の物質に浸透させて、該硬ろう材と微粒子状の物質からなる接着組成物による接合層を形成することで異種部材同士を嵌合構造を介して接合する方法である。

この際、該微粒子状の物質と粉体状の硬ろう材を混合したものを、該微粒子状の物質からなる層および同層を被覆する板状あるいは粉体状の硬ろう材の代わりに使用してもよい。また、第２の態様は、凹部を有する部材（１）の凹部表面に微粒子状の物質（４）を均一に敷き詰め、該微粒子状の物質からなる層に密着するように、１または複数の穿孔された穴に硬ろう材（３）が挿入された凸部を有する部材（２）を配置して、加圧下で所定の温度に加温して硬ろう材を溶融させ、溶融させた硬ろう材を該微粒子状の物質に浸透させることによって、該硬ろう材と微粒子状の物質からなる接着組成物による接合層を形成することで異種部材同士を嵌合構造を介して接合する方法である。また、第３の態様は、予め先端部に硬ろう材と微粒子状の物質からなる層（５）を形成した凸部を有する部材（２）を用意しておき、凹部を有する部材（１）の凹部表面に硬ろう材（６）を配置した上に当該層を有する凸部を有する部材を配置して、加圧下で所定の温度に加温し、該凸部を有する部材の先端に形成された硬ろう材と微粒子状の物質からなる層と、凹部を有する部材の凹部表面に配置した硬ろう材とを溶融し、硬ろう材と微粒子状の物質からなる接合層を形成することにより異種部材同士を嵌合構造を介して接合する方法である。

【００１５】　上記の第１、もしくは第２の態様においては、凹部を有する部材の凹部に微粒子状の物質を敷き詰めるに際し、当該物質によって形成される層に硬ろうが浸透した際に、目的たる熱応力緩和機能を発揮させるには、微粒子状の物質の平均粒径が１０μｍから５００μｍ、望ましくは２０μｍから１００μｍ程度である。平均粒径が上記下限を下回ると、接着組成物による接合層の密着性が充分に得られない場合があり、また上限値を超えると接合層を形成する接着組成物の微視的なレベルでの膨張係数等特性の不均質性が顕著になるために、その耐熱特性等が劣化する場合があり、望ましくない。その際、特定の粒度範囲内に属する粒子の粒度分布に占める割合が、好ましくは８０％以上、より好ましくは９０％以上、更に好ましくは９５％以上を占めるような粒子を使用することは、その充填密度等の最終製品の品質に直接影響を及ぼす各種要因の管理の点から好ましい。このような粒度分布を有する破砕形状粒子を使用した場合で、硬ろう材中のその充填密度は４５～６０％程度となる。この様な粒度分布を有する粒子からなる微粒子状の物質を調製するには、例えば、ＪＩＳ－Ｚ－８８０１に準拠するふるいで粒子をふりわけることで粒度を合わせるればよい。すなわち、ふるい目の呼び寸法で三段階程度異なるふるい、例えば呼び寸法７５μｍと４５μｍのふるいを、あるいは同６３μｍと３８μｍのふるいをそれぞれ上下のふるいとしてふりわけ、目の粗いふるいを通過し、目の細かいふるい上に残ったものを使用すればよい。なお、これ以上に厳しい幅で管理を行うことは、製造価格等に影響する割には、その接合強度などに及ぼす技術的効果の向上は少ない。

【００１６】　また粒子の平均粒径の分布を積極的に操作して、例えば平均粒子径が異なる二組もしくはそれ以上の組の粒子を混合することで充填率を上げることもできる。かくして敷き詰められた該微粒子状の物質からなる層の厚さは通常０．１ｍｍから２ｍｍ、好ましくは０．３ｍｍから１．０ｍｍである。微粒子の粒径等の制約から０．１ｍｍ未満では、均質な接合層を形成することが難しく、また２ｍｍ以上の接合組成物層は、接合部における残留応力の緩衝等の効果が上がらない割に、その厚さを達成するために浸透させる硬ろう材の量が増えるために、接合部において形状上制約がでたり、あるいは、形成された同層の均質度が充分でない等の弊害を生ずることがあり、好ましくない。

【００１７】　かくして形成した該微粒子状の物質からなる層の少なくとも一部分を被覆するように硬ろう材を配置する。硬ろう材を配置するに際しては、図１に示した様に、板状あるいは粒状等の硬ろう材を該微粒子状の物質の層と緊密に接触させる様に所望の容量分を配置して使用すればよい。この際、硬ろうは、所望の容量分の重量があれば、該微粒子状の物質上全面を覆ってもよいし、一部分のみを覆ってもよい。

【００１８】　あるいは、異種部材のいずれか一方、通常は、図２に示したように、嵌合構造を構成する凸部を有する部材であって凹部を有する部材とは相異なる種類の部材の一部に設けられた硬ろう材を配置する箇所に、溶融した硬ろう材を所望する量流し込んだ後、凝固させたものを該微粒子状の物質からなる層の上に配置し使用してもよい。また、該硬ろう材を配置する箇所に、機械加工等で形状を整えた硬ろう材を挿入して使用してもよい。嵌合構造において、雄部を構成する凸部を有する部材の形状等によっても異なるが、配置した微粒子状の物質に必要量の硬ろう材を好適に溶融、浸出させられればよいので、使用する硬ろう材の量は、溶融、浸出させうる範囲内で任意に選択できることはいうまでもない。その配置の個所も、特別に制限があるものではなく、例えば、図２に示したように中央部に設けてもよいし、また複数箇所に設けてもよい。

【００１９】　なお、ここで少なくとも一部分を被覆する様に硬ろう材を配置するとは、緊密に形成された微粒子層の少なくとも一部に緊密に硬ろう材が接触するように位置決めし、かくして、位置決め組み合わせた部材を加温し、硬ろう材を溶融さた際に、硬ろうが該微粒子層の緊密度を崩すことなくその間隙に侵入し、その後降温した際に、均質な接着剤組成物層を形成するように硬ろう材を配することをいう。接合に際しては、上記のように調整して嵌合した異種部材同士に加圧下で硬ろう材を溶融浸透させた際、緊密に形成された微粒子層は、その嵩密度を変化させることなく硬ろう材を吸収し、残余の

硬ろう材は嵌合部間隙を経て外部に排出される結果、当該部位は均質な該接着剤組成物層を介して緊密に接合されることとなる。

【００２０】　溶融させる温度としては、使用する硬ろう材が溶融し、微粒子状の物質からなる層に浸透してゆく必要があるので、通常は該硬ろう材の融点より１０～１５０℃高い温度、望ましくは融点より１０～５０℃高い温度が適当である。これより高い温度においては、硬ろう材と接合される金属材料との濡れが活発となりすぎて硬ろう材が該金属材料側に濡れあがり現象を起こして、接合部にいわゆる巣と称される空胞部を生じる等の弊害が生じたり、ろう材中の蒸気圧の高い元素が蒸発して、ろう材組成が変動する等の弊害がでることが多い。但し、活性材としてＴｉ等の高融点金属を添加する場合は、硬ろう材とこれら添加材が合金化することで、実際の融点が硬ろう材より上昇することがあるため、その活性材の材質、添加量を勘案して上記範囲より高い温度が選択されることもある。例えば、ＢＡｇ８を硬ろう材として浸透させる場合において、活性材たるＴｉを微粒子に対する重量比で５～３０％程度添加する場合は、ＢＡｇ８の融点よりも１００～３００℃程度高い温度を選択することが好ましい。なお、活性材を微粒子に添加する場合は、予め適切な温度範囲を設定するための小規模試験を行うことが好ましい。

【００２１】　また、この温度の保持時間は接合させる異種部材同士の性状にもよるが、昇温、保持、降温の加熱履歴において、ろう材が溶融開始してから凝固終了するまで、通常５～９０分、好ましくは１０～３０分程度である。短すぎると当該部位の実体温度が、制御されている炉内温度に追従しきれずにろう材が溶融しないばあいがあり、長時間の保持は、被接合材とろう材との間、微粒子状の物質とろう材との間で反応が起こる場合、当該反応が進みすぎる等の弊害がでる場合があるので選定には留意する必要がある。加圧力は、敷き詰められた微粒子状の物質をろう材が浸透し凝固するまで緻密に保ち、また当該微粒子状の物質の層とろう材と間に間隙を生じさせないために必要である。この加圧力は、接合される異種部材同士の材質、大きさ、性状等を考慮して適宜選択すればよい。例えば、第１の態様においては、通常０．１ＭＰａ～２．０ＭＰａ程度、第２の態様においては、０．５ＭＰａ～３０．０ＭＰａ程度を一応の目安とすればよい。なお、第１の態様においては、敷き詰められた微粒子状の物質をろう材が浸透し凝固するまで緻密に保つことのみでその目的を達することができるので、加圧する圧力は低くてもよい。一方、第２の態様においては、硬ろう材層が溶融して微粒子状物質の層に吸収されることで生じる該硬ろう材層の厚さに相当する間隙を、該硬ろうの溶融と同時に加圧することにより消失させることで接合部材と該接着部材層を緊密に接合させ、当該微粒子状の物質の層とろう材との間に間隙を生じさせないためにも応力が必要とされることによる。

【００２２】　本発明に係る接合方法における、第３の態様として、予め先端部に硬ろう材と微粒子状の物質からなる層を形成した凸部を有する部材を用意しておき、凹部を有する部材の凹部表面に硬ろう材を配置した上に当該層を有する凸部を有する部材を配置して、加圧下で所定の温度に加温して、該硬ろう材と微粒子状の物質からなる接着組成物による接合層を形成することで異種部材同士を嵌合構造を介して接合する方法がある。この手法においては予め形成しておく接着組成物層に使用される硬ろう材、微粒子状の物質、それを形成するための温度条件等は、第１の態様、第２の態様と同一であるので省略する。当該層を形成するにあたっては、高密度カーボン等の治具を利用して加圧下で当該層を形成した後、機械加工で凹部に合う様に形状を修正して使用するとよい。また、凹部を有する部材との接合で使用する硬ろう材は、先の硬ろう材と同一組成のものであってもよいが、近似組成で融点がやや低いものであればより望ましい。同一の硬ろう材を使用すると、場合によって同接着剤組成層が再度溶融して同層の一部に空胞部が発生すること等があるためである。加熱処理により当該硬ろう材を溶融し、当該接着剤層の最表面で同層と渾然一体化して新しい接着剤層を形成し、第１の態様や第２の態様に示したのと同一の効果を有する接合体が形成される。この際、当該接着剤層の最表面で同層と渾然一体化して新しい接着剤層を形成しない場合、すなわち、拡大観察した場合に、当該接着剤層と区分観察される金属ろう材層が残留する場合には、製造された複合部材の耐熱特性等が、実装中に著しく劣化するので望ましくない。

【００２３】　本発明において使用する二種以上の異種部材の組合わせとしては、例えば窒化アルミニウムや窒化珪素等のセラミックス製部材と、モリブデンやコバール、タングステン等の金属部材との組み合わせ、あるいは、製造原料をことにする等の異種セラミック製部材同士の組合わせが挙げられる。より具体的には半導体ウエハー製造において使用される、内蔵する金属電極や金属発熱体によって静電チャック機能やヒーター機能を発揮する窒化アルミニウム部材と、当該内蔵される金属電極材等へ給電を行う端子として接合される例えば金属モリブデン部材とを嵌合させ接合することからなる複合部材等が挙げられる。

【００２４】　本発明に係る接着物組成物に使用する硬ろう材としては、Ａｕ、Ａｇ、Ｃｕ、Ｐｄ、Ａｌ、Ｎｉ等の金属をベースとしたろう材が挙げられる。勿論、接合する部材とろう材との濡れ性、あるいは接合する部材もしくは分散粒子とろう材との反応性、あるいはろう材が使用される温度条件等との関係で、より適切なものを使用すればよい。接合部材の使用環境温度が５００℃以下のものとしては、Ａｌ系ろう材、例えば、ＢＡ４００４（Ａｌ－１０Ｓｉ－１．５Ｍｇ）等が好適に使用され

る。接合部材の使用環境温度が５００℃以上のものとしては、Ａｕ、ＢＡｕ－４（Ａｕ－１８Ｎｉ）、ＢＡｇ－８（Ａｇ－２８Ｃｕ）等が好適に使用される。

【００２５】　熱応力を効率的に低下させるため、換言すれば、膨張係数が制御された接着剤組成物からなる接合層を形成するためには、微粒子状の物質の種類ならびに硬ろう材に対するその充填密度を調整することが必要となり，そのためには，接着剤組成物層の熱膨張係数を調整することが必要となる。熱応力を低下させる微粒子状の物質は、その膨張係数が小さいほど接着剤組成物層の熱膨張係数を下げるのには有利である。微粒子状の物質の硬ろう材に対する充填密度は、体積比で３０から９０%、望ましくは４０から７０％となる様にする。この際、微粒子状の物質の充填密度を上げることは、膨張係数を下げるには有利であるが、あまり充填密度を高くすることは、接合強度の劣化を伴う場合があるので好ましくない。また、低い場合は、所望とする膨張係数に達しない場合があるので留意が必要である。すなわち、膨張係数の調整は、微粒子状の物質の種類を所望の膨張係数が達成できるように選択するか、微粒子状の物質の粒度分布を適宜選択することで達成される。

【００２６】　熱応力を低下させる微粒子状の物質として、セラミックを使用する場合には、硬ろう材との濡れが問題となるが、セラミックを金属で被覆すればよい。金属で被覆する場合には、スパッタリングで被覆をする手法が有効である。また、メッキを使用する方法も使用可能である。メッキ方法としては特に制限はないが、無電解メッキが好適に使用される。また、金属メッキ処理がなくても、セラミック表面に窒化物、酸化物、炭化物等の活性材の反応層を形成することで濡れを確保することができる。すなわち、Ｔｉ等の添加物をろう材、もしくは、微粒子状物質中に微粒子として混合することで、加える手法を用いてもよい。該活性材の添加量は、硬ろう材に対し、重量比で０．５～５%程度が好適である。

【００２７】　本発明の第２の側面である、嵌合構造を構成する凹部を有する部材と、嵌合構造を構成する凸部を有する部材であって凹部を有する部材とは相異なる種類の部材とからなり、上記異種部材は相互に嵌合され、基本的には、微粒子状の物質と硬ろう材からなる接着剤組成物からなる接合層により接合されている、二種以上の異種部材からなる複合部材は、上記の方法により製造可能である。凹部を有する部材の壁面と、同凹部を有する部材とは相異なる種類の部材からなる凸部を有する部材との壁面との間に形成される、嵌合構造部における異種部材の壁面間のクリアランスは、通常、０．０１～０．３mm程度、好ましくは、０．０２～０．０７mm程度とするとよい。上記下限を逸脱すると、部材同士を嵌合することができない恐れがあり、また、上記上限を逸脱すると、上述した様にろう材が偏って充填されたりする不都合が生ずる恐れがあり好ましくない。

【００２８】

【実施例】　以下実施例を挙げて、本発明を説明するが、勿論、本発明は、これらの例により何等制限されるものではないことはいうまでもない。接合状態ならびに耐熱サイクル特性の評価は、耐熱サイクル雰囲気に曝露した前後の、接合部の引張り強度の劣化が起こっているか否かによって判定した。この際、曝露前に対して２５%以上の強度劣化を引き起こしたものは不良と判断した。また参考のため、接合層断面観察により接合部に基材割れや剥離が生じていないか否かも調査した。

【００２９】（実施例１）嵌合構造を構成する凹部を有する部材として、部材の厚さが１０．０mm、部材に垂直に穿孔された勘合用の切り込み構造部の穴の直径が５．０７mm、その深さが９．５mmの窒化アルミニウム部材と、嵌合構造を構成する凸部を有する部材であって、凹部を有する部材とは相異なる種類の部材として直径５．０mm、長さ１５．０mmの円柱状の金属モリブデン製部材を使用して以下の条件で接合した。

【００３０】　凹部を有する部材である窒化アルミニウム製部材の約０．５μmのＮｉメッキ処理が施された凹部表面に、微粒子状の物質として、表面に約０．５μmのＮｉメッキ処理を施した平均粒径４７μmのアルミナを均一に敷き詰めた。当該アルミナ層の厚さは、０．８mmであった。ついで、該粒子状の物質からなる層に緊密に接するように硬ろう材として、直径５．０mm、厚さ０．５mmのＡ５００５（Ａｌ－０．８Ｍｇ：融点６５０℃）を配置した。その上に表面に約０．５μmのＮｉメッキ処理を施した金属モリブデン製部材を緊密に嵌合配置し、２．５ＭＰａの圧力を加えつつ、加熱し、７００℃に到達後１０分間同温度を保持して、接合した。硬ろう材は該加熱中に溶融し微粒子状の物質からなる層中に浸透し、複合接着層を形成した。かくして形成された複合接着層により両部材を接合した。形成された複合接着層の厚さは０．８mmであった。

【００３１】　こうして得られた接合部材を熱サイクル試験に供した。熱サイクル試験条件は、同接合部材を昇温速度２．５℃／ｍｉｎで６０℃から１８０℃へ昇温し、１８０℃へ到達後直ちに降温速度－２．５℃／ｍｉｎ で６０℃へ降温し、６０℃へ到達後、直ちに再び同一のサイクルを繰り返すという処理を５０回にわたって繰り返した。接合あがりの部材と接着層の断面概観写真を図４（ａ）に、窒化アルミニウムと接着層の断面拡大写真を図４（ｂ）に、熱サイクル試験に曝露した後の窒化アルミニウムと接着層の断面拡大写真を図４（ｃ）に示す。また，接合あがりならびに熱サイクル試験に曝露した後の接合部材の引張り試験結果を表１に示す。

【００３２】　本実施例の比較材として金属ろう材Ａ５００５のみで、金属モリブデン製部材と窒化アルミニウム部材を接合した複合部材を製作し同一の評価に供した。両部材間に微粒子状の物質が入らない点を除き、使

用した部材の寸法、表面処理、接合条件等の条件は全て同一とした。接合時に形成された金属ろう材Ａ５００５の接合層の厚さは０．１ｍｍであった。接合あがりの部材と接着層の断面概観写真を図５（ａ）に、窒化アルミニウムと接着層の断面拡大写真を図５（ｂ）に、熱サイクル試験に曝露した後の窒化アルミニウムと接着層の断面拡大写真を図５（ｃ）に示す。また、接合あがりならびに熱サイクル試験に曝露した後の接合部材の引張り試験結果を表１に示す。

【００３３】（実施例２）嵌合構造を構成する凹部を有する部材として、部材の厚さが１０．０ｍｍ、部材に垂直に穿孔された勘合用の切り込み構造部の穴の直径が５．０７ｍｍ、その深さが９．５ｍｍの窒化アルミニウム部材と、嵌合構造を構成する凸部を有する部材であって、凹部を有する部材とは相異なる種類の部材として直径５．０ｍｍ、長さ１５．０ｍｍの円柱状の金属モリブデン製部材であってその一方の端面に直径２．５ｍｍ、長さ３．０ｍｍの硬ろう材を収納できる箇所を設け、同箇所に同一の大きさを有する硬ろう材を嵌め込んだものを使用して以下の条件で接合した。

【００３４】　凹部を有する部材である窒化アルミニウム製部材の、約０．５μｍのＮｉめっき処理が施された凹部表面に，微粒子状の物質として、表面に約０．５μｍのＮｉめっき処理を施した平均粒径４７μｍのアルミナを均一に敷き詰めた。この際に、挿入されたる同物質を、端面が平滑な直径５．０ｍｍの棒で軽く突き固めてその平坦性と、充填性を確保した。この操作を行なった後の当該アルミナ層の厚さは、０．８ｍｍであった。ついで、図２に模式的に示したように、微粒子状の物質からなる層に緊密に接するように硬ろう材として、Ａ５００５（Ａｌ－０．８Ｍｇ：融点６５０℃）を内蔵するように配置した金属モリブデン製部材を勘合し、０．５ＭＰａの圧力を加えつつ、加熱した。加熱履歴は、実施例１と同様である。形成された複合接着層の厚さは０．８ｍｍであった。こうして得られた接合部材を熱サイクル試験に供した。熱サイクル試験条件は、実施例１と同様である。なお、接合あがりならびに熱サイクル試験に曝露した後の接合部材の引張り試験結果を表１に示す。本実施例２における、接合部における接合面積は、対実施例１の接合部における接合面積の７５％であった。

【００３５】（実施例３）嵌合構造を構成する凹部を有する部材として、部材の厚さが１０．０ｍｍ、部材に垂直に穿孔された勘合用の切り込み構造部の穴の直径が５．０７ｍｍ、その深さが９．５ｍｍの窒化アルミニウム＊部材と、嵌合構造を構成する凸部を有する部材であって、凹部を有する部材とは相異なる種類の部材として直径５．０ｍｍ、長さ１５．０ｍｍの円柱状の金属モリブデン製部材であってその一方の端面に、予め実施例１および２に記載の硬ろう材と微粒子状の物質から構成される接着組成剤層を形成してあるものを使用して以下の条件で接合した。

【００３６】　凹部を有する部材である窒化アルミニウム製部材の、約０．５μｍのＮｉメッキ処理が施された凹部表面に金属ろう材ＢＡ４００４（Ａｌ－１０Ｓｉ－１．５Ｍｇ：融点５８０℃）を緊密に接するように置き、凹部を有する部材とは相異なる種類の部材として円柱状の金属モリブデン製部材であってその一方の端面に予め実施例１および２に記載の硬ろう材と微粒子状の物質から構成される接着組成剤層を形成してあるものを金属ろう材と緊密に接するように配した。ここで使用した先端に接着組成剤層を形成してあるモリブデン製部材は、別途高密度カーボン製治具を使用して円柱状のモリブデンの端部に、約０．５μｍのＮｉメッキ処理が施された平均粒径４７μｍのアルミナを均一に敷き詰めた上に、金属ろう材Ａ５００５を溶融、浸透させて当該接着組成剤層を形成した上に、当該層の厚さが０．８ｍｍ、直径が５．０ｍｍとなるように研削加工したものである。この際ろう材を浸透させた際の温度条件等は、実施例１の接合条件と同一とした。この嵌合部材に０．５ＭＰａの圧力を加えつつ、加熱し、６１０℃に到達後１０分同温度を保持し、接合させた。

【００３７】　なお、本実施例で金属ろう材としてＢＡ４００４を使用したのは、モリブデン製部材の先端に形成してある接着組成剤層に使用されている硬ろう材と同様のＡ５００５を使用すると、同接着剤組成層が再度溶融していわゆる巣が発生する等の問題生ずるため、同接着剤層を形成する硬ろう材の組成と近似の組成の硬ろう材であって、融点が低いものを使用したものである。この加熱処理により当該硬ろう材ＢＡ４００４は溶融し、当該接着剤層の最表面で、同層と渾然一体化して、断面の拡大観察では実施例１と判定しがたい接合形態が実現された。こうして得られた接合部材を熱サイクル試験に供した。熱サイクル試験条件は、実施例１と同様である。なお、接合あがりならびに熱サイクル試験に曝露した後の接合部材の引張り試験結果を表１に示す。

【００３８】

【表１】

実施例、比較例の別	接合上がり強度（ＭＰａ）	熱サイクル試験後の強度（ＭＰａ）	熱サイクル試験前後の強度の比（％）
実施例　１	４７２３	４９６９	１０５
実施例　２	５０６９	４７９４	９５
実施例　３	４６３９	４５４９	９８
比較例	２５６６	１１６６	４５

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【００３９】　上記の表１に示した試験結果、および貼付の写真から、本発明に係る方法により接合された複合部材は、比較例のように金属ろうのみを使用した場合において、発生する接合部での熱履歴曝露時の剥離が生起せず、接合強度の劣化が起こっていないことが明らかである。

【００４０】

【発明の効果】　本願発明の接合方法によれば、嵌合構造を介して接合しなければならない二種以上からなる異種部材を接合する場合において、該異種部材同士における嵌合構造部分の壁面のクリアランスが、所定量の硬ろう材を流し込み得るだけの充分な間隔を有しない場合においても、異種部材同士を充分な強度を以て接合することができる。また、充分な接合強度および耐熱強度を有する嵌合構造を介して接合された二種以上からなる異種部材同士からなる複合部材が提供できるという効果を発揮するものである。

【図面の簡単な説明】

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【図１】　本発明に係る接合方法の一態様を模式的に示す。

【図２】　本発明に係る接合方法の別の態様を模式的に示す。

【図３】　本発明に係る接合方法のも一つ別の態様を模式的に示す。

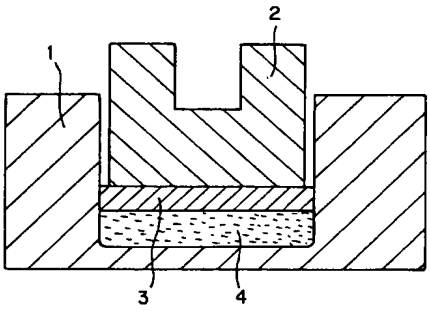
【図４】　（ａ）実施例１の接合あがり時における断面構造の写真、（ｂ）接合あがり時点での接合界面部の断面構造の拡大写真、（ｃ）熱サイクル試験後における接合界面部の断面構造の拡大写真を示す。

【図５】　（ａ）比較例の接合あがり時における断面構造の写真、（ｂ）接合あがり時点での接合界面部の断面構造の拡大写真、（ｃ）熱サイクル試験後における接合界面部の断面構造の拡大写真を示す。

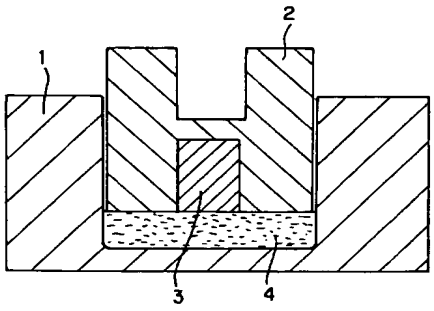
【符号の説明】

１…凹部を有する部材、２…凸部を有する部材、３…硬ろう材、４…微粒子状の物質、５…硬ろう材と微粒子状の物質からなる層、６…硬ろう材。

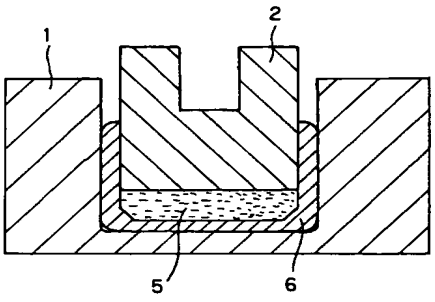
【図１】



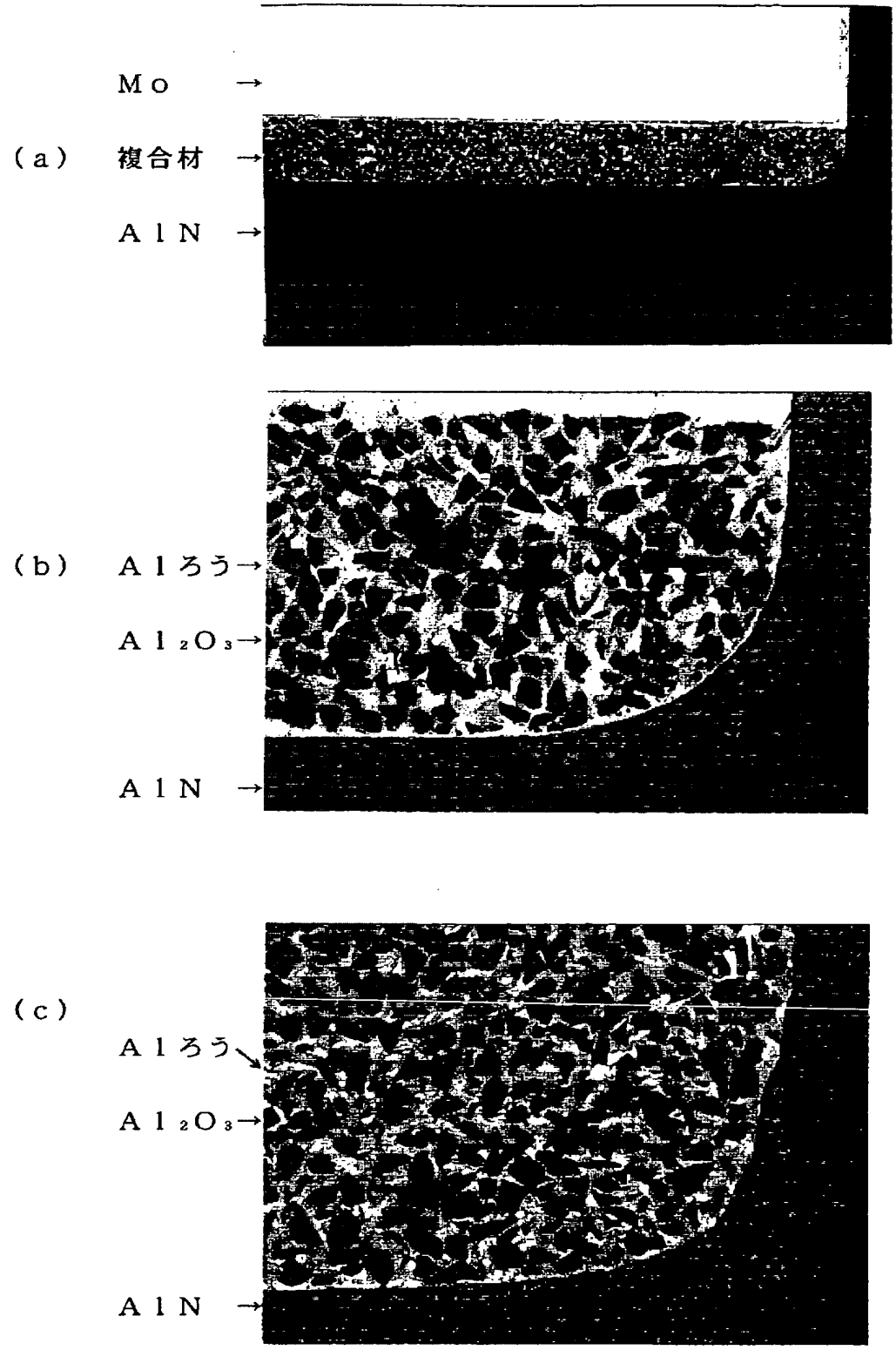
【図２】



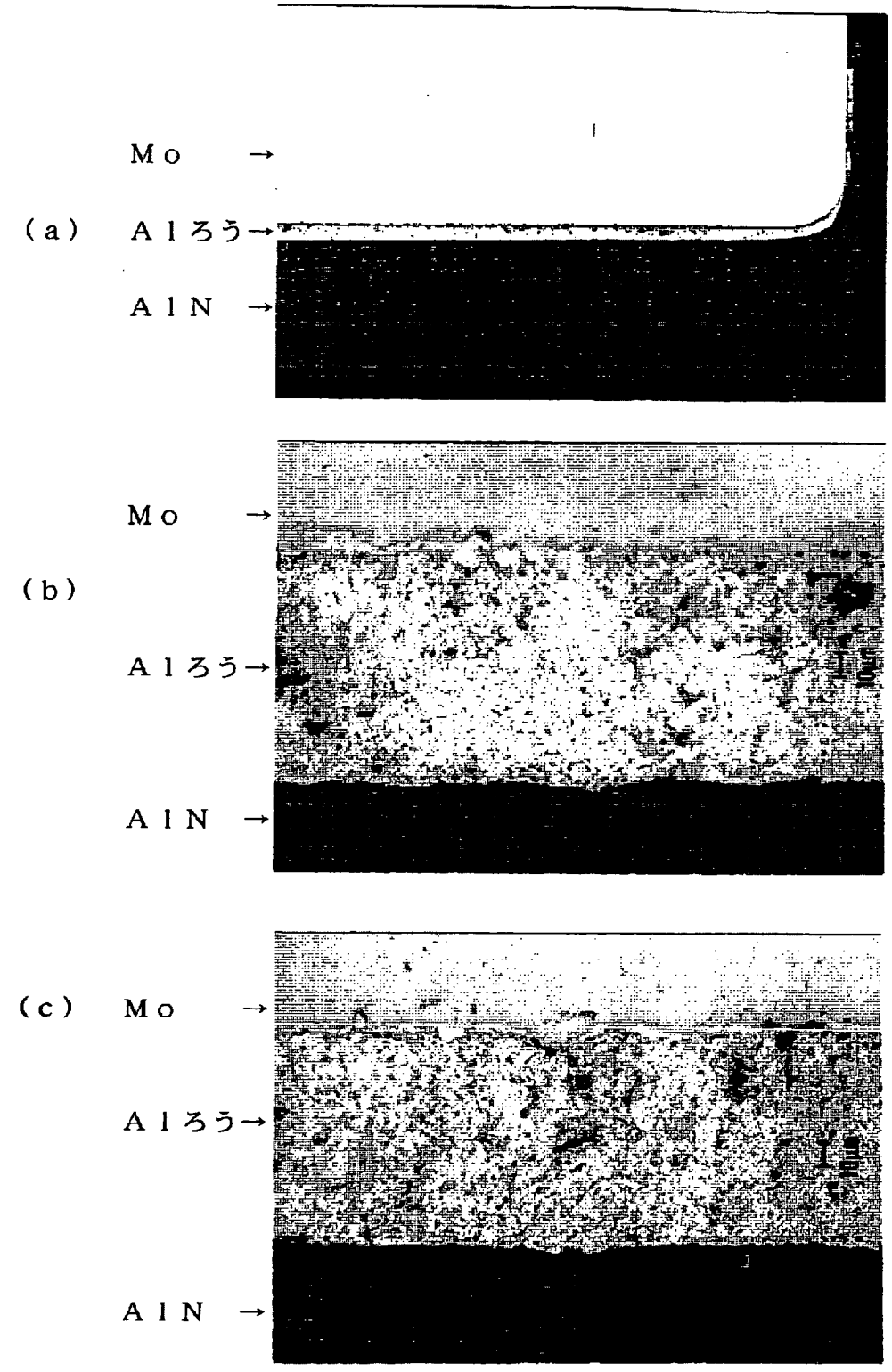
【図３】



【図４】



【図５】



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(72)発明者　來田　雅裕
愛知県名古屋市瑞穂区須田町２番56号　日本碍子株式会社内

Ｆターム(参考)　4G026 BA01 BA16 BB21 BC01 BC02 BD01 BD02 BF15 BF16 BF17 BF18 BF20 BF22 BF43 BG02 BG09

JAPANESE [JP,2001-010873,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] How to manufacture a compound member which consists of different-species members which are characterized by providing the following, and which consist of a production process which forms a junctional zone and joins different-species members through fitting structure A member which has a crevice which constitutes fitting structure a member which is a member which has heights which constitute fitting structure, and has a crevice -- difference -- it facing making a member of a class fit in and joining it, and, after covering with particle-like material at homogeneity the crevice surface of a member which has a crevice Brazing solder material, such as the shape of tabular or fine particles, is arranged so that a part of layer [at least] which consists of material of the shape of this particle may be covered. Furthermore, so that the crevice surface of a member which arranges a member which has heights or has a crevice may be covered with particle-like material at homogeneity and it may stick to a layer which consists of material of the shape of this particle [whether a member which has heights by which brazing solder material was inserted in a hole where 1 or plurality was punched is arranged, and] Or a production process which arranges a member which has heights which prepare for a point beforehand a member which has heights in which a layer which consists of material of the shape of brazing solder material and a particle was formed, have arranged brazing solder material upwards on the crevice surface of a member which has a crevice, and have the layer concerned What was prepared in this way is warmed to a temperature predetermined in the bottom of pressurization, this brazing solder material is fused, impregnation is carried out into particle-like material, and it is the material of the shape of this brazing solder material and a particle.
[Claim 2] A method according to claim 1 of consisting of arranging brazing solder material, such as the shape of tabular or fine particles, so that a part of layer [at least] which consists of material of the shape of this particle may be covered, after a production process which arranges a member which has the above-mentioned heights covers with particle-like material at homogeneity the crevice surface of a member which has a crevice, and arranging a member which has heights further.
[Claim 3] A method according to claim 1 of consisting of a thing which arrange a member which has heights by which brazing solder material was inserted in a hole where 1 or plurality was punched so that it might stick to a layer which a production process which arranges a member which has the above-mentioned heights covers with particle-like material at homogeneity the

crevice surface of a member which has a crevice, and becomes from material of the shape of this particle and to arrange.

[Claim 4] A method according to claim 1 of consisting of arranging a member which has heights which a production process which arranges a member which has the above-mentioned heights prepares for a point beforehand a member which has heights in which a layer which consists of material of the shape of brazing solder material and a particle was formed, have arranged brazing solder material upwards on the crevice surface of a member which has a crevice, and have the layer concerned.

[Claim 5] A method given in claim 1 characterized by at least one side of this different-species member being a member made from a ceramic thru/or any 1 term of 4.

[Claim 6] A method given in claim 1 to which one side of this different-species member is characterized by another side being a metal member by member made from a ceramic thru/or any 1 term of 5.

[Claim 7] A method given in claim 1 characterized by being the material of the shape of a particle to which this particle reduces thermal stress thru/or any 1 term of 6.

[Claim 8] A method given in claim 1 characterized by for a base metal of this brazing solder material being the brazing solder material which is Au, Ag, Cu, Pd, aluminum, or nickel, and material of the shape of this particle being a ceramic particle, a cermet particle, or a low expansion metal particle thru/or any 1 term of 7.

[Claim 9] A method given in claim 1 characterized by material of the shape of this particle being the ceramic particle by which the surface was covered with plating or a spatter with a metal thru/or any 1 term of 8.

[Claim 10] It is the compound member joined by junctional zone which it is a member which has a crevice which constitutes fitting structure, and the member which has heights which constitute fitting structure, and consists of a member of a different kind to a member which has a crevice, and the above-mentioned different-species member fits in mutually, and consists of particle-like material and brazing solder material.

[Claim 11] this -- a compound member according to claim 10 whose at least one of two or more sorts of the different-species members is a member made from a ceramic.

[Claim 12] this -- a compound member according to claim 10 or 11 two or more sorts of whose different-species members are the combination of a metal member and a member made from a ceramic.

[Claim 13] A compound member according to claim 10 characterized by being the material of the shape of a particle to which this particle reduces thermal stress.

[Claim 14] A compound member given in claim 10 characterized by for a base metal of this brazing solder material being the brazing solder material which is Au, Ag, Cu, Pd, aluminum, or nickel, and material of the shape of this particle being a ceramic particle, a cermet particle, or a low expansion metal particle thru/or any 1 term of 13.

JAPANESE [JP,2001-010873,A]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the cementation method of the compound different-species member which comes to join the different-species member which consists of two or more sorts joined through fitting structure, and this compound different-species member. Furthermore, it is the compound member which consists of two or more sorts of different members in detail, and is related with the method of joining two or more sorts of different-species members for manufacturing the compound member to which these different-species members were joined through fitting structure with the adhesives constituent by which the expansion coefficient was controlled, and this compound member with the adhesives constituent by which the expansion coefficient was controlled.
[0002]
[Description of the Prior Art] Although the method of using wax material is in cementation of a different-species member, for example, cementation to the member made from a ceramic, and a metal member The thermal stress resulting from the difference of the coefficient of thermal expansion of the wax material and member which were used during the cooling actuation after the cementation in an elevated temperature in order to join these different-species member between different-species members occurs. Exfoliation can be produced in a cementation interface, and when one member is brittle, a crack is produced near the cementation interface, and neither desired bonding strength nor airtightness can be acquired. Since the product which these abnormalities generated in the manufacture process must be disposed of as a defective, it serves as a cause which pushes up the cost of the product of these compound member. Moreover, in costing a heat cycle at the time of use, these abnormalities occur after use of a fixed period, and also serve as a cause to which the reliability of a product is reduced.
[0003] After plating the surface of the plane of composition of the member made from a ceramic with a metal, for example, metals, such as nickel, in order to secure **** of the member made from a ceramic, and wax material in joining a different-species member using wax material, both members are set, and a suitable gap is opposed and is arranged, wax material is slushed into this gap and the method to which it is made to join is usually adopted. Moreover, even if there is no metal plating processing, there is also the technique of adding additives, such as Ti which can secure **** by forming reaction layers, such as a nitride and an oxide, in the ceramic surface, into

wax material. However, these methods are not enough to reduce thermal stress, and since a crack is often formed in the brittle member side made from a ceramic, or exfoliation is produced in a joint to thermal stress and various engine performance, such as not only bond strength but airtightness demanded as a compound member, is affected, it is not desirable. Moreover, the method of using the elasticity metal which can ease stress as middle material is usually adopted by being rich in reactivity with the method and ceramic which are used as middle material, and deforming plastically a metal with a low coefficient of thermal expansion as a method of easing thermal stress, in the case of cementation. However, such technology is also made into the problem and the lowness of the problem resulting from the differential thermal expansion between wax material and a member, for example, a heat cycle property, etc. cannot necessarily say it as the high technology of versatility. Moreover, although there is a high-pressure solid-state-welding method as technology under current development, the present condition is that there is an unsolved technical problem in putting in practical use, therefore bond strength sufficient by this method has not come out.

[0004] On the other hand, as cored solder, use it for fixing with a semiconductor chip and a substrate, and although what mixed the powder object which consists of the quality of the material with the melting point higher than solder is indicated by JP,6-126479,A This cored solder by making only the center section of the solder main part fill up with the powder object which consists of the quality of the material with the melting point higher than solder Although it aims at canceling poor solder **** resulting from the powder object which exists also in the surface which the conventional cored solder has, and making the bonding strength in a cementation interface increase if it puts in another way However, this cored solder is not effective in the fall of thermal stress, therefore effective in solving the problem resulting from the thermal stress between the members joined or between a member and wax material.

[0005] this invention person etc. found out the fall phenomenon of the bonding strength near the cementation interface by the thermal stress between the cooling actuation after the cementation in an elevated temperature, and the glue constituent between two or more sorts of different-species members which is not made to generate a crack during the cooling actuation by the weak member to thermal stress, holding moderate bond strength for different-species members variously as a result of examination, in order to attain the above-mentioned purpose. About the concrete contents, it has applied as Japanese Patent Application No. No. 52971 [ten to] on February 18, Heisei 10.

[0006] Namely, the thing for which there is little constraint by a class, a configuration, etc. of joint material, and a cementation configuration also uses brazing solder material with much room of selection as the base as a result of examining many things in view of the above present condition, By adding the material of the shape of a particle which reduces thermal stress to this brazing solder material The fall phenomenon of the bonding strength near the cementation interface by the thermal stress between the cooling actuation after the cementation in an elevated temperature does not raise different-species members, either, holding moderate bond strength. Moreover, crack initiation is not carried out during the cooling actuation by the weak member to thermal stress, the thing between two or more sorts of different-species members for which cementation achievement can be carried out is found out, and it results in the above-mentioned patent

application.

[0007] Keep sufficient gap to join mutually two or more sorts of different-species members which differ in the thermal stress as a method of joining using the above-mentioned constituent, and it is made to arrange face to face mutually. Slush the above-mentioned constituent into this gap, or it is filled up with the ceramic or cermet particle of the specified quantity. the brazing solder material of the specified quantity succeedingly changed into the melting condition -- slushing -- subsequently -- cooling -- this, although the method of joining two or more sorts of different-species members, and manufacturing a compound member is indicated in the above-mentioned patent application If it remains as it is, it cannot be used for cementation of the members which do not have sufficient gap which can slush the brazing solder material of the specified quantity.

[0008] When the different-species member which consists of two or more sorts which must be joined through fitting structure is joined, and an about 0.01-0.30mm very narrow thing tends to be chosen and it is going to join both members as path clearance especially, unless it also fills up the side of a member with wax material equally generally as much as possible, it is not rare for various un-arranging to arise. On the other hand, when this path clearance is larger than the above-mentioned maximum, a crack may occur with the residual stress which is generated by not filling up this path clearance with wax material equally at the time of melting of wax material and by which endocyst was carried out. If this is explained more concretely, in case the member which has a cylinder-like crevice, and the member which has cylinder-like heights will be fitted in, for example Since there is a certain amount of [the wax material with which the path clearance of the shape of a cylinder formed from both members should be filled up equally / this path clearance] additional coverage When inclined only toward one side by some causes, the balance of the heat shrink stress in the process which cools wax material and is made to solidify collapses, the member which has cylinder-like heights is pulled by the one direction, as a result, residual stress arises, and a crack may be generated. Furthermore, there are also a request on the dimensional accuracy of the compound member as a finished product and a request on a fine sight. Therefore, by slushing the brazing solder material of the specified quantity into the members which have only the close clearance parts above in this way from this close clearance part, since things were substantially impossible, these different-species members were unjoinable by the above-mentioned method. In addition, path clearance means the width of face of the crevice which exists between the wall surfaces of these different-species members in a part for the fitting structured division here.

[0009]

[Problem(s) to be Solved by the Invention] Therefore, when making it cementation of these different-species members, the technical problem which this invention tends to solve [when the path clearance between the wall surfaces of these different-species members in a part for the fitting structured division does not have sufficient gap which can slush the brazing solder material of the specified quantity] It is in offering the different-species member joined by the method of forming a junctional zone and joining with the adhesives constituent by which the expansion coefficient was controlled through fitting structure in these different-species members, and this method.

[0010]

[Means for Solving the Problem] A member which has variously a crevice which constitutes fitting structure as a result of examination in order that this invention person etc. may solve the above-mentioned technical problem, a member which is a member which has heights which constitute fitting structure, and has a crevice -- difference -- it facing making a member of a class fit in and joining it, and, after covering with particle-like material at homogeneity the crevice surface of a member which has a crevice Arrange brazing solder material, such as the shape of tabular or fine particles, so that a part of layer [at least] which consists of material of the shape of this particle may be covered, and a member which has heights further is arranged. Warm to a temperature predetermined in the bottom of pressurization, fuse brazing solder material, and this fused brazing solder material is made to permeate into a layer which consists of material of the shape of this particle. A member which has a crevice which forms a junctional zone by adhesives constituent by which an expansion coefficient which consists of material of the shape of this brazing solder material and a particle was controlled, or constitutes fitting structure, Are the member which has heights which constitute fitting structure, and it faces making a member of a class which is different from each other fit in, and joining to a member which has a crevice. So that the crevice surface of a member which has a crevice may be covered with particle-like material at homogeneity and it may stick to a layer which consists of material of the shape of this particle A member which has heights by which brazing solder material was inserted in a hole where 1 or plurality was punched is arranged. Warm to a temperature predetermined in the bottom of pressurization, fuse brazing solder material, and this fused brazing solder material is made to permeate into a layer which consists of material of the shape of this particle. [whether a junctional zone by adhesives constituent by which an expansion coefficient which consists of material of the shape of this brazing solder material and a particle was controlled is formed, and] A member which has heights in which a layer which becomes a point from material of the shape of brazing solder material and a particle beforehand was formed is prepared. Arrange a member which has heights in which a layer which has arranged only brazing solder material upwards on the crevice surface of a member which has a crevice, and consists of material of the shape of brazing solder material and a particle concerned was formed, and it warms to a predetermined temperature under pressurization. A layer which consists of material of the shape of brazing solder material formed at a tip of a member which has these heights, and a particle, By fusing brazing solder material arranged on the crevice surface of a member which has a crevice, and forming a junctional zone which consists of an adhesives constituent by which an expansion coefficient which consists of material of the shape of brazing solder material and a particle was controlled A member which has a crevice which finds out that different-species members are joinable through fitting structure, and constitutes fitting structure which is the 1st side of this invention, It is the member which has heights which constitute fitting structure, and a member which has a crevice completes a method of making a member of a class which is different from each other fit into, and joining it, and is a thing.

[0011] Moreover, a member which has a crevice which constitutes fitting structure which fitted in in this way and was joined, Are the member which has heights which constitute fitting structure, and it becomes the member which has a crevice from a member of a class which is different from each other at least. A compound member which consists of two or more sorts of different-species

members characterized by joining the above-mentioned different-species members with an adhesives constituent by which an expansion coefficient which fits in mutually and consists of particle-like material and brazing solder material was controlled After mounting finds out having an improved heat cycle property, and completes the 2nd side of this invention.

[0012]

[Embodiment of the Invention] It faces the member which has the crevice which constitutes fitting structure, and the member which is a member which has the heights which constitute fitting structure, and has a crevice making the member of the class which is different from each other fit in [side / of this invention / 1st], and joining. After covering with particle-like material at homogeneity the crevice surface of the member which has a crevice Brazing solder material, such as the shape of tabular or fine particles, is arranged so that a part of layer [at least] which consists of material of the shape of this particle may be covered. Furthermore, so that the crevice surface of the member which arranges the member which has heights or has a crevice may be covered with particle-like material at homogeneity and it may stick to the layer which consists of material of the shape of this particle [whether the member which has the heights by which brazing solder material was inserted in the hole where 1 or plurality was punched is arranged, and] Or the production process which arranges the member which has the heights which prepare for the point beforehand the member which has the heights in which the layer which consists of material of the shape of brazing solder material and a particle was formed, have arranged brazing solder material upwards on the crevice surface of the member which has a crevice, and have the layer concerned, Warm what was prepared in this way to a temperature predetermined in the bottom of pressurization, and this brazing solder material is fused. The junctional zone which is made to carry out impregnation and consists of this brazing solder material and particle-like material is formed into particle-like material, and it is related with the method of manufacturing the compound member which consists of different-species members which consist of a production process which joins different-species members through fitting structure.

[0013] In addition, the conditions adopted on the occasion of cementation in addition to the above, for example, cooling conditions etc., should just follow the Japanese-Patent-Application-No. No. 52971 [ten to] specification concerning the application on February 18, Heisei 10 at a publication. Therefore, the contents of the Japanese-Patent-Application-No. No. 52971 [ten to] specification concerning the application on February 18, Heisei 10 are quoted by reference here.

[0014] The 1st mode of the cementation method concerning the 1st side of this invention After covering with particle-like material (4) at homogeneity the crevice surface of the member (1) which has a crevice Brazing solder material (3), such as the shape of tabular or fine particles, is arranged so that a part of layer [at least] which consists of material of the shape of this particle may be covered. Furthermore, arrange the member (2) which has heights, warm to a temperature predetermined in the bottom of pressurization, and melting of the brazing solder material is carried out. It is the method of joining different-species members through fitting structure by forming the junctional zone by the adhesion constituent which the brazing solder material which carried out melting is made to permeate the material of the shape of this particle, and consists of material of the shape of this brazing solder material and a particle. Under the present circumstances, you may use it instead of the brazing solder material of the shape of tabular [which covers the layer

and this layer which consist of material of the shape of this particle what mixed fine-particles-like brazing solder material with the material of the shape of this particle], or fine particles. Moreover, so that the 2nd mode may cover with particle-like material (4) at homogeneity the crevice surface of the member (1) which has a crevice and it may stick to the layer which consists of material of the shape of this particle By arranging the member (2) which has the heights by which brazing solder material (3) was inserted in the hole where 1 or plurality was punched, warming to a temperature predetermined in the bottom of pressurization, and making the brazing solder material to which melting of the brazing solder material was carried out, and it carried out melting permeate the material of the shape of this particle It is the method of joining different-species members through fitting structure by forming the junctional zone by the adhesion constituent which consists of material of the shape of this brazing solder material and a particle. Moreover, the 3rd mode prepares the member (2) which has the heights in which the layer (5) which becomes a point from the material of the shape of brazing solder material and a particle beforehand was formed. The member which has the heights which have arranged brazing solder material (6) upwards on the crevice surface of the member (1) which has a crevice, and have the layer concerned is arranged. The layer which consists of material of the shape of the brazing solder material formed at the tip of the member which warms to a temperature predetermined in the bottom of pressurization, and has these heights, and a particle, It is the method of joining different-species members through fitting structure by forming the junctional zone which fuses the brazing solder material arranged on the crevice surface of the member which has a crevice, and consists of material of the shape of brazing solder material and a particle.

[0015] In the above-mentioned 1st or the 2nd above-mentioned mode, when brazing solder permeates the layer which faces covering with particle-like material the crevice of the member which has a crevice, and is formed with the material concerned, in order to demonstrate the purpose slack thermal stress relaxation function, 500 micrometers of mean particle diameter of particle-like material are 20 micrometers to about 100 micrometers desirably from 10 micrometers. Since the heterogeneity of properties, such as an expansion coefficient in the microscopic level of the adhesion constituent which forms a junctional zone, will become remarkable if the adhesion of the junctional zone by the adhesion constituent may not fully be acquired if mean particle diameter is less than the above-mentioned minimum, and a upper limit is exceeded, the heat-resistant property etc. may deteriorate and it is not desirable. The rate of occupying to the particle size distribution of the particle which belongs in a specific size range is preferably desirable [using a particle which occupies 95% or more still more preferably] in that case 90% or more more preferably 80% or more from the point of management of the various factors which have direct effect on the quality of final products, such as the pack density. By the case where the crushing configuration particle which has such particle size distribution is used, the pack density in brazing solder material becomes about 45 - 60%. In order to prepare the material of the shape of a particle which consists of a particle which has such particle size distribution, **** which doubles grain size by **ing and dividing a particle with the sieve based on JIS-Z -8801 is good. namely, a sieve which is different about three steps with the nominal dimension of a sieve opening, for example, the nominal dimension of 75 micrometers and a 45-micrometer sieve, -- or -- said -- what is necessary is to ** a sieve (63 micrometers and 38 micrometers) as an up-and-down sieve, respectively, to

divide it, to pass a sieve with a coarse eye, and just to use what remained in the plus sieve with a fine eye In addition, there is little improvement in the technical effect which managing by severer width of face than this exerts on the bonding strength etc. although a manufacture price etc. is influenced.

[0016] Moreover, a filling factor can also be raised by mixing the particle of 2 sets from which distribution of the mean particle diameter of a particle is positively operated, for example, mean particle diameter differs, or the group beyond it. The thickness of the layer which consists of material of the shape of this particle with which it was covered in this way is usually 0.3mm to 1.0mm preferably 2mm from 0.1mm. In less than 0.1mm, from constraint of the particle size of a particle etc. It is difficult to form a homogeneous junctional zone. Moreover, a cementation constituent layer 2mm or more In order that the amount of the brazing solder material made to permeate in order to attain [which effects, such as a buffer of the residual stress in a joint, do not go up] the thickness comparatively may increase, whenever [homogeneity / of this layer which constraint on a configuration came out or was formed in the joint] may produce not enough evil, and it is not desirable.

[0017] Brazing solder material is arranged so that a part of layer [at least] which consists of material of the shape of this particle formed in this way may be covered. What is necessary is to face arranging brazing solder material, and just to use a desired capacitive component for the appearance which was shown in drawing 1 and which contacts closely tabular or the brazing solder material of granular ** in the layer of the material of the shape of this particle like, arranging to it. Under the present circumstances, as long as brazing solder has the weight of a desired capacitive component, it may cover the whole material top surface of the shape of this particle, and may cover only a part.

[0018] or either of the different-species members and the member which is a member which has the heights which constitute fitting structure, and usually has a crevice as shown in drawing 2 -- difference -- after [which asks for the fused brazing-solder material] carrying out an amount style, the thing which made solidify may arrange and use on the layer which consists of material of the shape of this particle for the part which arranges the brazing-solder material prepared in a part of member of a class. Moreover, you may use it by machining etc., inserting the brazing solder material which prepared the configuration in the part which arranges this brazing solder material. In fitting structure, it cannot be overemphasized that the amount of melting and the brazing solder material used since what is necessary is just to leach can choose the brazing solder material of an initial complement as the material of the shape of an arranged particle suitably at arbitration within melting and limits which can leach although it changes with configurations of a member of having the heights which constitute the male section etc. The part of the arrangement does not have a limit specially, either, as shown in drawing 2 , it may be established in a center section, and it may be established in two or more places.

[0019] in addition, arranging brazing solder material so that at least a part may be covered here It positions so that brazing solder material may contact closely a part of particle layer [at least] formed closely. In this way When it trespasses upon the gap and the temperature is lowered after that, without warming positioning combination ****** and brazing solder breaking down the closeness of this particle layer for brazing solder material in the melting **** case, it says allotting

brazing solder material so that a homogeneous adhesives constituent layer may be formed. When it adjusts as mentioned above and the different-species members which fitted in are made to carry out melting osmosis of the brazing solder material under pressurization on the occasion of cementation, the particle layer formed closely absorbs brazing solder material, without changing the bulk density, and as a result of discharging residual brazing solder material outside through a fitting section gap, the part concerned will be closely joined through this homogeneous adhesives constituent layer.

[0020] Since it is necessary to permeate the layer which the brazing solder material to be used fuses as a temperature which carries out melting, and consists of particle-like material, a temperature usually higher 10-150 degrees C than the melting point of this brazing solder material and a desirable temperature higher 10-50 degrees C than the melting point are suitable. In a temperature higher than this, **** with the metallic material joined to brazing solder material becomes active too much, evils, such as producing the vacuole section called the so-called nest by the joint, arise, or an element with the high vapor pressure in wax material evaporates [brazing solder material gets wet in this metallic material side, a stage fright phenomenon is caused,], and the evil of changing a wax material presentation comes out in many cases. However, since it is that brazing solder material and these add-in material alloy and the actual melting point may rise from brazing solder material when adding refractory metals, such as Ti, as activity material, the quality of the material of the activity material and an addition are taken into consideration, and a high temperature may be chosen from the above-mentioned range. For example, when making BAg8 permeate as brazing solder material and adding the activity material slack Ti about 5 to 30% by the weight ratio to a particle, it is desirable to choose a temperature higher about 100-300 degrees C than the melting point of BAg8. In addition, when adding activity material to a particle, it is desirable to perform the bench test for setting up a suitable temperature requirement beforehand.

[0021] Moreover, in the heating hysteresis of a temperature up, maintenance, and a temperature fall, although the holding time of this temperature is based also on the description of the different-species members to join, it is usually about 10 - 30 minutes preferably for 5 to 90 minutes after wax material carries out melting initiation until it carries out coagulation termination. If too short, when wax material may not fuse without the ability of the substance temperature of the part concerned following whenever [furnace temperature / which is controlled] and a reaction will occur between particle-like material and wax material between jointed material and wax material, since evils, like the reaction concerned progresses too much may come out, maintenance of long duration needs to care about selection. Since it is kept precise and a gap is not produced in between with the layer of the material of the shape of particle concerned, and wax material until wax material permeates and solidifies the particle-like material with which it was covered, welding pressure is required. What is necessary is just to choose this welding pressure suitably in consideration of the quality of the material of the different-species members joined, magnitude, description, etc. For example, what is necessary is just to usually let a 0.5MPa - 30.0MPa degree be a temporary standard in a 0.1MPa(s) - 2.0MPa degree and the 2nd mode in the 1st mode. In addition, in the 1st mode, since the purpose can be attained only by keeping it precise until wax material permeates and solidifies the particle-like material with which it was covered, the pressure

to pressurize may be low. The gap equivalent to the thickness of this brazing solder material layer produced by a brazing solder material layer fusing and on the other hand being absorbed by the layer of particle-like material in the 2nd mode Also in order to join this jointing material layer to joint material closely by making it disappear by pressurizing melting and coincidence of this brazing solder and not to produce a gap between the layer of the material of the shape of particle concerned, and wax material, it is because stress is needed.

[0022] The member which has the heights in the cementation method concerning this invention which formed the layer which becomes a point from the material of the shape of brazing solder material and a particle beforehand as the 3rd mode is prepared. The member which has the heights which have arranged brazing solder material upwards on the crevice surface of the member which has a crevice, and have the layer concerned is arranged. It warms to a temperature predetermined in the bottom of pressurization, and there is the method of joining different-species members through fitting structure by forming the junctional zone by the adhesion constituent which consists of material of the shape of this brazing solder material and a particle. Since it is the same as that of the 1st mode and the 2nd mode, the temperature conditions for forming the material of the shape of the brazing solder material used for the adhesion constituent layer beforehand formed in this technique and a particle and it etc. are omitted. If in charge of forming the layer concerned, after forming the layer concerned under pressurization using fixtures, such as high density carbon, it is good to use it, correcting a configuration so that a crevice may be suited by machining. Moreover, although it may be the thing of the same presentation as previous brazing solder material, if the brazing solder material used by cementation to the member which has a crevice has a little low melting point at an approximation presentation, it is more desirable. When the same brazing solder material is used, it is because this adhesives presentation layer may fuse again and the vacuole section may occur in a part of this layer by the case. The brazing solder material concerned is fused by heat-treatment, a new adhesives layer is formed in complete harmony with this layer on the maximum surface of the adhesives layer concerned, and the zygote which has the same effect as having been shown in the 1st mode and 2nd mode is formed. Under the present circumstances, when the metal wax material layer by which partition observation is carried out with the adhesives layer concerned when [which does not form a new adhesives layer in complete harmony with this layer on the maximum surface of the adhesives layer concerned] a case, i.e., expansion observation, is carried out remains, since the heat-resistant property of the manufactured compound member etc. deteriorates remarkably during mounting, it is not desirable.

[0023] As combination of two or more sorts of different-species members used in this invention, the combination of members made from a different-species ceramic, such as making the combination or the manufacture raw material of members made from the ceramics, such as alumimium nitride and silicon nitride, and metal members, such as molybdenum, and covar, a tungsten, into things, for example, is mentioned. The alumimium nitride member which is more specifically used in semiconductor wafer manufacture and which demonstrates an electrostatic chuck function and a heater function with the metal-electrode metallurgy group heating element to build in, the compound member which consists of a thing which is joined as a terminal which supplies electric power to the metal-electrode material concerned built in, and which a metal

molybdenum member is made to fit in for example, and join are mentioned.

[0024] As brazing solder material used for the adhesion object constituent concerning this invention, the wax material which used metals, such as Au, Ag, Cu, Pd, aluminum, and nickel, as the base is mentioned. Of course, what is necessary is just to use a more suitable thing by relation with the temperature conditions for which the reactivity of the wettability of the member and wax material to join, the member to join, or a particulate material and wax material or wax material is used. The operating environment temperature of joint material is suitably used as a thing 500 degrees C or less for aluminum system wax material 4004 (aluminum-10Si-1.5Mg), for example, BA etc. The operating environment temperature of joint material is suitably used for Au, BAu-4 (Au-18nickel), BAg-8 (Ag-28Cu), etc. as a thing 500 degrees C or more.

[0025] If it puts in another way in order to reduce thermal stress efficiently, in order to form the junctional zone which consists of an adhesives constituent by which the expansion coefficient was controlled, it is necessary to adjust the pack density to particle-like the class and brazing solder material of material, and, for that purpose, it necessary to adjust the coefficient of thermal expansion of an adhesives constituent layer. The material of the shape of a particle to which thermal stress is reduced is so advantageous to lowering the coefficient of thermal expansion of an adhesives constituent layer that the expansion coefficient is small. It is made for the pack density to the brazing solder material of particle-like material to become 40 to 70% from 30 desirably 90% by the volume ratio. Under the present circumstances, although it is advantageous to lowering an expansion coefficient to raise the pack density of particle-like material, since it may be accompanied by deterioration of bonding strength, it is not so desirable to make pack density high. Moreover, to be low, since the expansion coefficient considered as a request may not be reached, consideration is required. That is, adjustment of an expansion coefficient is attained by choosing so that the expansion coefficient of a request of the class of particle-like material can be attained, or choosing the particle size distribution of particle-like material suitably.

[0026] What is necessary is just to cover a ceramic with a metal, although **** with brazing solder material poses a problem as material of the shape of a particle to which thermal stress is reduced in using a ceramic. When covering with a metal, the technique of covering with sputtering is effective. Moreover, the method of using plating is also usable. Although there is especially no limit as the plating method, electroless deposition is used suitably. Moreover, even if there is no metal plating processing, **** is securable by forming the reaction layer of activity material, such as a nitride, an oxide, and carbide, in the ceramic surface. That is, the technique of adding additives, such as Ti, by mixing as a particle in wax material or particle-like material may be used. About 0.5 - 5% of the addition of this activity material is suitable to brazing solder material at a weight ratio.

[0027] The member which has the crevice which constitutes the fitting structure which is the 2nd side of this invention, It is the member which has the heights which constitute fitting structure, and becomes the member which has a crevice from the member of the class which is different from each other, and the above-mentioned different-species member fits in mutually. Fundamentally The compound member which is joined by the junctional zone which consists of an adhesives constituent which consists of particle-like material and brazing solder material and which consists of two or more sorts of different-species members can be manufactured by the above-mentioned

method. the wall surface of the member which has a crevice, and the member which has this crevice -- difference -- the path clearance between the wall surfaces of the different-species member in the fitting structured division formed between wall surfaces with the member which has the heights which consist of a member of a class is usually good preferably to be referred to as about 0.02-0.07mm about 0.01-0.3mm. It is [a possibility that un-arranging / which was mentioned above / with which wax material inclines and is filled up like / may arise] and is not desirable, if there is a possibility that it cannot fit in in members if it deviates from the above-mentioned minimum and it deviates from the above-mentioned maximum.

[0028]

[Example] Although an example is given below and this invention is explained, of course, it cannot be overemphasized that this invention is not what is restricted in any way by these examples. Evaluation of a cementation condition and a heat-resistant cycle property was judged by whether deterioration of the tensile strength of a joint before and after exposing to a heat-resistant cycle ambient atmosphere has taken place. Under the present circumstances, it was judged that what caused 25% or more of deterioration on the strength to exposure before was poor. Moreover, it investigated whether neither a base material crack nor exfoliation would have arisen in the joint by junctional-zone cross-section observation for reference.

[0029] The alumimium nitride member the depth of whose the diameter of the hole of the slitting structured division for checking and verifying where the thickness of a member was punched at right angles to 10.0mm and a member as a member which has the crevice which constitutes fitting structure is 5.07mm, and is 9.5mm, (Example 1) the member which is a member which has the heights which constitute fitting structure, and has a crevice -- difference -- it joined on condition that the following as a member of a class using the member made from metal molybdenum of the shape of a cylinder with a diameter [of 5.0mm], and a length of 15.0mm.

[0030] The crevice surface on which about 0.5-micrometer nickel plating processing of the member made from alumimium nitride which is a member in which it had a crevice was performed was covered with the alumina with a mean particle diameter of 47 micrometers which performed about 0.5-micrometer nickel plating processing to the surface as particle-like material at homogeneity. The thickness of the alumina layer concerned was 0.8mm. Subsequently, A5005 [with a diameter / of 5.0mm / and a thickness of 0.5mm] (aluminum-0.8Mg: melting point of 650 degrees C) has been arranged as brazing solder material so that the layer which consists of material of the shape of this particle may be touched closely. Having carried out fitting arrangement of the member made from metal molybdenum which performed about 0.5-micrometer nickel plating processing to the surface on it closely, and applying the pressure of 2.5MPa, it heated, and this temperature was held at 700 degrees C for after [attainment] 10 minutes, and it joined to them. Brazing solder material permeated into the layer which fuses during this heating and consists of particle-like material, and formed the compound glue line. Both members were joined by the compound glue line formed in this way. The thickness of the formed compound glue line was 0.8mm.

[0031] In this way, the thermal cycling test was presented with the obtained joint material. Thermal cycling test conditions carry out the temperature up of this joint material from 60 degrees C to 180 degrees C by the programming rate of 2.5 degrees C / min, and are -2.5 degrees C in temperature

fall speed / min immediately after attainment to 180 degrees C. The temperature was lowered to 60 degrees C and processing in which the same cycle was repeated immediately again was repeated 50 times after attainment to 60 degrees C. The cross-section enlargement of alumimium nitride after exposing the cross-section enlargement of alumimium nitride and a glue line for the cross-section general-view photograph of the member of cementation stage fright and a glue line to drawing 4 (a) at a thermal cycling test at drawing 4 (b), and a glue line is shown in drawing 4 (c). Moreover, the tensile test result of the joint material after being exposed to cementation stage fright and a thermal cycling test is shown in a table 1.

[0032] As comparison material of this example, only by the metal wax material A5005, the compound member which joined the member made from metal molybdenum and the alumimium nitride member was manufactured, and the same evaluation was presented. All of conditions, such as a size of the member used except for the point that particle-like material does not enter, among both members, surface treatment, and cementation conditions, presupposed that it is the same. The cementation layer thickness of the metal wax material A5005 formed at the time of cementation was 0.1mm. The cross-section enlargement of alumimium nitride after exposing the cross-section enlargement of alumimium nitride and a glue line for the cross-section general-view photograph of the member of cementation stage fright and a glue line to drawing 5 (a) at a thermal cycling test at drawing 5 (b), and a glue line is shown in drawing 5 (c). Moreover, the tensile test result of the joint material after being exposed to cementation stage fright and a thermal cycling test is shown in a table 1.

[0033] The alumimium nitride member the depth of whose the diameter of the hole of the slitting structured division for checking and verifying where the thickness of a member was punched at right angles to 10.0mm and a member as a member which has the crevice which constitutes fitting structure is 5.07mm, and is 9.5mm, (Example 2) Are the member which has the heights which constitute fitting structure, and as a member of the class which is different from each other with the member which has a crevice The diameter of 5.0mm, The part which is the member made from metal molybdenum of the shape of a cylinder with a length of 15.0mm, and can contain brazing solder material with a diameter [of 2.5mm] and a length of 3.0mm to the end face of one of these was established, and it joined on condition that the following using what inserted in this part the brazing solder material which has the same magnitude.

[0034] The crevice surface on which about 0.5-micrometer nickel plating processing of the member made from alumimium nitride which is a member which has a crevice was performed was covered with the alumina with a mean particle diameter of 47 micrometers which performed about 0.5-micrometer nickel plating processing to the surface as particle-like material at homogeneity. In this case, it was inserted, and with the rod whose end face is the smooth diameter of 5.0mm, the slack said material was poked lightly, was hardened, and that surface smoothness and restoration nature were secured. The thickness of the alumina layer concerned after performing this actuation was 0.8mm. Subsequently, it heated, having carried out the checking and verifying of the member made from metal molybdenum arranged as brazing solder material so that A5005 (aluminum-0.8Mg: melting point of 650 degrees C) may be built in so that the layer which consists of particle-like material might be touched closely, and applying the pressure of 0.5MPa, as typically shown in drawing 2 . Heating hysteresis is the same as that of an example 1. The thickness of the formed

compound glue line was 0.8mm. In this way, the thermal cycling test was presented with the obtained joint material. Thermal cycling test conditions are the same as an example 1. In addition, the tensile test result of the joint material after being exposed to cementation stage fright and a thermal cycling test is shown in a table 1. The plane-of-composition product in a joint in this example 2 was 75% of a plane-of-composition product in the joint of the pair example 1.

[0035] The alumimium nitride member the depth of whose the diameter of the hole of the slitting structured division for checking and verifying where the thickness of a member was punched at right angles to 10.0mm and a member as a member which has the crevice which constitutes fitting structure is 5.07mm, and is 9.5mm, (Example 3) Are the member which has the heights which constitute fitting structure, and as a member of the class which is different from each other with the member which has a crevice The diameter of 5.0mm, It is the member made from metal molybdenum of the shape of a cylinder with a length of 15.0mm, and joined to the end face of one of these on condition that the following beforehand using what has formed the adhesion presentation agent layer which consists of brazing solder material given in examples 1 and 2, and particle-like material.

[0036] The metal wax material BA 4004 (aluminum-10Si-1.5Mg: melting point of 580 degrees C) is put on the crevice surface on which about 0.5-micrometer nickel plating processing of the member made from alumimium nitride which is a member which has a crevice was performed so that it may touch closely. the member which has a crevice -- difference -- what has formed the adhesion presentation agent layer which is cylinder-like the member made from metal molybdenum as a member of a class, and is beforehand constituted from brazing solder material of a publication and particle-like material by examples 1 and 2 at the end face of one of these was allotted so that metal wax material might be touched closely. The member made from molybdenum which has formed the adhesion presentation agent layer at the tip used here The fixture made from high density carbon is used separately. At the edge of cylinder-like molybdenum Upwards homogeneity was covered with the alumina which is the mean particle diameter of 47 micrometers to which about 0.5-micrometer nickel plating processing was performed, and the grinding process of the metal wax material A5005 is carried out so that it was made to permeate and the adhesion presentation agent layer concerned was formed, and also [melting and] the thickness of the layer concerned may be set to 0.8mm and a diameter may be set to 5.0mm. Under the present circumstances, the temperature conditions at the time of making wax material permeate etc. presupposed that it is the same as that of the cementation conditions of an example 1. Applying the pressure of 0.5MPa(s) to this fitting member, it heats, and this temperature was held at 610 degrees C for after [attainment] 10 minutes, and they was joined.

[0037] In addition, having used BA4004 as metal wax material by this example The problem student **** sake of this adhesives presentation layer fusing again and the so-called nest occurring, if the A5005 [same] as the brazing solder material currently used for the adhesion presentation agent layer currently formed at the tip of the member made from molybdenum is used, It is the brazing solder material of the presentation of the brazing solder material which forms this adhesives layer, and an approximate presentation, and the melting point uses a low thing. The brazing solder material BA 4004 concerned fused by this heat-treatment, and it is the maximum surface of the adhesives layer concerned, it harmonized completely with this layer, and

the cementation gestalt which is hard to judge to be an example 1 was realized in expansion observation of a cross section. In this way, the thermal cycling test was presented with the obtained joint material. Thermal cycling test conditions are the same as an example 1. In addition, the tensile test result of the joint material after being exposed to cementation stage fright and a thermal cycling test is shown in a table 1.

[0038]

[A table 1]

実施例、比較例の別	接合上がり強度（ＭＰａ）	熱サイクル試験後の強度（ＭＰａ）	熱サイクル試験前後の強度の比（％）
実施例　1	４７２３	４９６９	１０５
実施例　2	５０６９	４７９４	９５
実施例　3	４６８９	４５４９	９８
比較例	２５６６	１１６６	４５

[0039] It is clear that the compound member's joined by the method concerning this invention from the test result shown in the above-mentioned table 1 and the photograph of pasting the exfoliation at the time of heat history exposure in the joint generated when only a metal wax is used like the example of a comparison does not occur, and deterioration of bonding strength has not taken place.

[0040]

[Effect of the Invention] the case where it does not have sufficient gap into which the path clearance of the wall surface for the fitting structured division in these different-species members can slush the brazing solder material of the specified quantity when joining the different-species member which consists of two or more sorts which must be joined through fitting structure according to the cementation method of the invention in this application -- also setting -- different-species members -- sufficient reinforcement -- with, it is joinable. Moreover, the effect that the compound member which consists of different-species members which consist of two or more sorts joined through the fitting structure of having sufficient bonding strength and strength in high temperature can be offered is demonstrated.

[Translation done.]

JAPANESE [JP,2001-010873,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] One mode of the cementation method concerning this invention is shown typically.
[Drawing 2] Another mode of the cementation method concerning this invention is shown typically.

[Drawing 3] Mode also with that [one] another of the cementation method concerning this invention is shown typically.
[Drawing 4] (a) The photograph of the cross-section structure at the time of cementation stage fright of an example 1, the enlargement of the cross-section structure of the cementation interface section in (b) cementation stage fright time, and the enlargement of the cross-section structure of the cementation interface section after the (c) thermal cycling test are shown.
[Drawing 5] (a) The photograph of the cross-section structure at the time of cementation stage fright of the example of a comparison, the enlargement of the cross-section structure of the cementation interface section in (b) cementation stage fright time, and the enlargement of the cross-section structure of the cementation interface section after the (c) thermal cycling test are shown.
[Description of Notations]
1 [-- Particle-like material, 5 / -- The layer which consists of material of the shape of brazing solder material and a particle, 6 / -- Brazing solder material.] -- The member, 2 which have a crevice -- The member, 3 which have heights -- Brazing solder material, 4

[Translation done.]